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SYSTEM FOR DETECTION AND RECOGNITION OF SIGN BOARDS ON ROADS

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ABSTRACT

System of Detection and Recognition of Sign Boards on Roads. This can be used to minimize the accidents count due to improper knowledge of signs on roads. it helps the drivers to guid the routeand also warn the driver about upcomeing dangers. This system inform in advance before the any danger occures. Purpose of this praper is to detect and recognize the signs and text on sign boards. Image capture though camera is pre-processed then sign board is detected and recognize the informatiom it contain.

KEYWORDS: Traffic Signs, Detection, Recognition, Convolutional Neural Network, Thresholding.

INTRODUCTION

Technology can play a major help tool in decreasing the count of road accidents. In general it is difficult for drivers to watch and get information about signs or text in sign board. In which driver can miss some of the warnings which can cause deaths. Sometimes due to road conditions or in nights, driver cannot read the sign boards like bump ahead or narrow bridge.

This Traffic Sign detection and Recognition sytem can be a good tool to help the road users by providing vaild information about the sign or text that are present on the sign boards, by this System driver get information in advance about the upcomeing dangers which can make driver to prepare for it and overcome the danger and drive safely. This System uses computer vision and pattern recognition to find signs and symbols in automatic detection and recognition.

MATERIALS AND METHODS:

Detection and Recognition of Traffic sign system works in two stages.

a. Detection- In this stage, Traffic sign presence or absence is detected.
b. Recognition- In this stage, If the Taffic Sign detected then, detected traffic sign is recognised and classified.

A important aspect is the need of a fast and reliable detection stage to boost-up the overall computation process. The detection stage serves as a primary step, enabling the system to identify and extract relevant knowledge from the input images. These extracted knowledge are subsequently forwarded as input to the recognition stage, where Convolutonal neural networks are leveraged for classification purposes. By employing Convolutional neural networks, the system can effectively categorize the detected traffic signs based on the different physical properties inherent to each type.

To enhance the efficiency and robustness of the classification process, a strategic approach involves useing three distinct databases for training purposes. This segmentation of databases allows for the training of the Convolutional neural networks to be specific to the unique attributes of each type of traffic sign. As a result, the classification process becomes more streamlined, resilient, and expeditious, thereby contributing to the overall speed and accuracy of the real-time traffic sign Detection and Recognition system.

The main steps included are :

1. Image capturing from camera.
2. Image enhancement for different lighting and whether conditions.
3. Selecting candidate objects based on colour.
4. Filtering the candidate objects based on shape.
5. Recognising the filtered object using neural network
6. Give visual image of the recognised sign and audio for the type of category of the traffic sign.

A. Image Capturing from Camera

Images are capturing useing the camera mounted on movie car. In this case, it is common for the captured images to contains blurriness, as well as variations in brightness, contrast, and clarity, which can become factors to effect image such as the time of day, location, and changeing weather conditions. Additionally, the presence of noise, stemming from climatic conditions, further complicates the detection process. Consequently, it becomes imperative to implement suitable pre-processing techniques to mitigate the impact of these diverse conditions on the images, thereby facilitating improved detection outcomes.

To address these challenges, a two-fold pre-processing approach is adopted. Firstly, the application of a Gaussian noise filter use in the reduction of noise, enhancing the overall quality of the captured images. Additionally, the Weiner filter is used further eliminate noise and improve the overall clarity of the images. These filtering techniques collectively contribute to minimizing the adverse effects of noise and other irregularities present in the images.

The pre-processed images are subsequently forwarded to the detection stage, ensuring that the input data for traffic sign recognition is optimized for improved accuracy and efficiency despite the challenging environmental conditions encountered

during image capture.

B. Sign Detection Stage

In this traffic sign detection based on color and shape analysis, an starting step involves the conversion of the captured image from the RGB color space to the YCbCr color space. The YCbCr color space is commonly used in digital video processing, facilitating the separation of luminance information into a single component (Y) and the representation of chrominance information as two color difference components (Cb and Cr). Specifically, Cb signifies the disparity between the blue component and a predefined reference value, while Cr represents the discrepancy between the red component and a designated reference value.

The conversion between the RGB and YCbCr color spaces can be represented using the following formulas:

For conversion from RGB to YCbCr:

$$Y=0.299\ R+0.587\ G+0.114\ B$$
$$Cb=0.564\ (B-Y)$$
$$Cr=0.713\ (R-Y)$$

These formulas elucidate the computation process involved in transforming the RGB values of each pixel to their corresponding YCbCr components. By performing this conversion, the luminance and chrominance information can be effectively separated, enabling a more focused analysis of the color and shape attributes essential for the detection of traffic signs.

1) Colour Based Analysis:

To facilitate the classification of traffic signs into two groups, namely red traffic signs and blue traffic signs, a important step involves the extraction of colors, given that colors serve as a key distinguishing feature of these signs. Consequently, a color segmentation process is implemented within the YCbCr color space to effectively isolate the target color regions within the image.

Following the color segmentation, a thresholding technique is applied to facilitate the distinct separation of red and blue color objects present in the image. The outcome of this step is the generation of a binary image, wherein the identified regions corresponding to red and blue colors are represented as foreground pixels, while the remaining regions are denoted as background pixels.

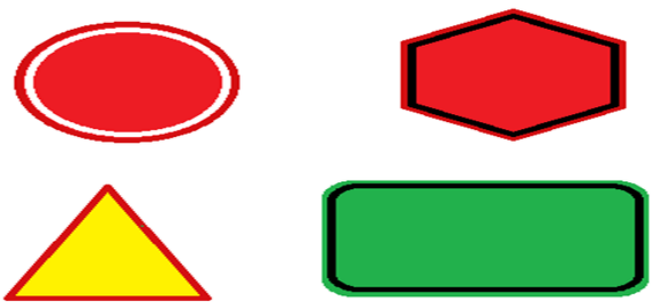
Furthermore, to refine the segmented regions and ensure the cohesiveness of the identified color objects, morphological operations are employed. Specifically, the application of morphological closing operations aids in the elimination of any isolated or stray pixels present within the segmented regions. This process contributes to the creation of a more defined and accurate representation of the red and blue color objects within the traffic sign images, thereby facilitating the subsequent stages of analysis and detection.

2) Shape Based Analysis:

In the process of traffic sign analysis, while color segmentation aids in the initial selection of candidate objects, subsequent filtering of these candidates is executed through shape detection. This involves the following steps:

Labeling Connected Regions: Connected candidate pixels are identified and grouped using the 8-neighbor connectivity approach, allowing for the formation of distinct candidate objects. As multiple candidate objects might be present, an efficient filtering mechanism is essential to retain potential traffic signs while eliminating irrelevant elements.

Leveraging Shape Characteristics: Shape detection serves as a pivotal filtering criterion, where four primary shapes—triangle (indicative of alert signs), circle (representative of compulsory signs), rectangle (symbolizing informational signs), and octagon (exclusively denoting STOP signs)—are utilized for classification purposes.



Template Matching Using Similarity Measures: The detection process hinges on the comparison of the binary image obtained from the color-segmented road sign with the predefined objects stored in the template database. To facilitate this comparison, the sample and segmented images must possess identical dimensions or undergo resizing. The evaluation of similarity is performed through the utilization of distance measures, such as the Euclidean distance, for cross-correlation in template matching.

Classification of Detected Signs: If the similarity measure surpasses a predetermined threshold value, the analyzed object is identified as a traffic sign and subsequently classified into one of the designated classes.

By implementing this systematic approach, the traffic sign detection system can effectively discern and categorize various traffic signs, contributing to enhanced road safety and efficient traffic management.

C. Sign Recognition/ Classification Stage

Upon successful identification of the presence of a traffic sign. The transmission of the processed frame to the recognition and classification stage for further analysis.

1) Pictogram thresholding:

After the confirmation of the presence of a traffic sign within the frame, the recognition process focuses on isolating and extracting the pictogram contained within the traffic sign. This entails the implementation of a thresholding operation, which involves the following steps:

Pixel-Wise Analysis: The frame obtained from the detection stage is subjected to a pixel-by-pixel analysis. Each pixel's intensity is compared against a predefined threshold value.

Thresholding: Pixels with intensity values exceeding the set threshold are converted to white pixels, whereas pixels with intensity values below the threshold are converted to black pixels. This process aids in segregating and highlighting the pictogram within the traffic sign, effectively distinguishing it from the background.

Stray Pixel Removal using Morphological Operations: Following the thresholding operation, any residual stray pixels are eliminated using morphological operations. Specifically,

morphological operations such as erosion and dilation are employed to refine the extracted pictogram, ensuring the removal of any extraneous or insignificant pixel clusters.

By executing these operations, the system can accurately and efficiently extract the pictogram embedded within the traffic sign, facilitating the subsequent stages of analysis and interpretation essential for precise traffic sign recognition.

2) Classification using neural network:

One kind of deep learning algorithm that works especially well for tasks involving picture recognition and processing is the convolutional neural network (CNN). Convolutional, pooling, and fully connected layers are some of the layers that make it up.

Convolutional Layer:

In a convolutional neural network (CNN), a type of layer known as a convolutional layer applies a collection of filters to the input data in order to produce feature maps that highlight the presence of features that have been discovered in the input. After each convolution operation, a CNN applies Rectified Linear Unit(ReLU) activation function transformation to the feature map, introducing nonlinearity to the model. The ReLU activation function is differentiable at all points except at zero. For values greater than zero, we just consider the max of the function.

Pooling:

Pooling is just reducing the size of the image without losing the features that we found with convolution. For example, a MaxPooling method will take in a shape of a matrix and return the larger value in that range. By doing this we can compress the image without losing the important features of this image

Flattening:

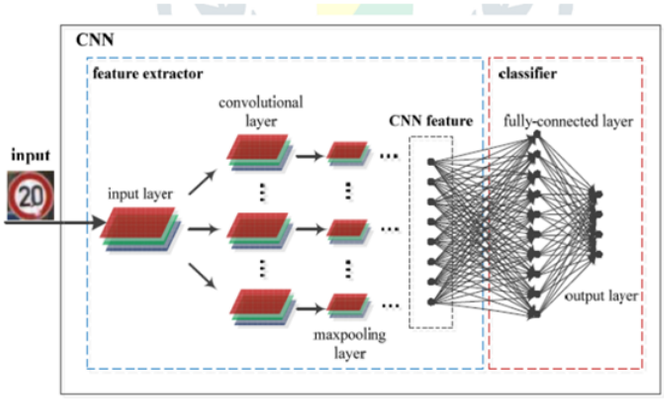
Flattening is nothing but converting a 3D or 2D matrix into a 1D input for the model this will be our last step to process the image.

Fully connected layer:

It takes the input from the previous layer and computes the final classification or regression task.

Output Layer:

The output from the fully connected layers is then fed into a logistic function for classification tasks like sigmoid or softmax which converts the output of each class into the probability score of each class



RESULTS:

This process involves taking vedio as input automatically from the camera. Using cv2 library the video is converted into collection of frames and those frames will be input as images .These image as input, performing preprocessing to standardize dimensions. Intial detect the Traffic sign and extracting features using a pre-trained Convolutional Neural Network (CNN) in recognition phase. which will generate the textual description.

(e.g:-Output as turn Right)

CONCLUSIONS: (Optional)

This paper outlines a real-time method for the detection and recognition of Indian traffic signs, organized into three distinct classes based on their shapes. The system operates through two fundamental steps: initial detection of the traffic sign board, followed by a recognition process. To achieve this, the system employs a pattern matching technique to facilitate the comparison of different traffic signs.

One of the key features of this system is its high-speed performance and robustness. It achieves this by excluding images containing signs with shapes diverging from the standard basic shapes at the initial stage. This selective process ensures that only relevant images are subjected to further analysis, thereby enhancing the system's efficiency and accuracy.

To enhance the system's performance even further, future improvements could focus on fortifying its resilience against varying weather conditions and accommodating tilted signs. Implementing modifications to address these challenges would contribute to the system's adaptability and reliability, enabling it to operate effectively in diverse environmental conditions and thereby ensuring improved road safety and traffic management.

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